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Sandia National Laboratories Advanced Simulation and Computing (ASC) Software Quality Plan Part 2: Mappings for the ASC Software Quality Engineering Practices Version 1.0

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Sandia National Laboratories Advanced Simulation and Computing (ASC) Software Quality Plan

Part 2: Mappings for the ASC Software Quality Engineering Practices

Version 1.0

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Abstract

The purpose of the Sandia National Laboratories Advanced Simulation and Computing (ASC) Software Quality Plan is to clearly identify the practices that are the basis for continually improving the quality of ASC software products. The plan defines the ASC program software quality practices and provides mappings of these practices to Sandia Corporate Requirements CPR 1.3.2 and 1.3.6 and to a Department of Energy document, *ASCI Software Quality Engineering: Goals, Principles, and Guidelines*. This document also identifies ASC management and software project teams' responsibilities in implementing the software quality practices and in assessing progress towards achieving their software quality goals.

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1 Introduction

This document, *Part 2: Mappings for the ASC Software Quality Engineering Practices*, contains the mappings for the practices and artifacts found in *Part 1: Practices of the Sandia National Laboratories Advanced Simulation and Computing (ASC) Software Quality Plan* (Software Quality Plan). The purpose of the mappings contained herein is to provide requirements traceability from the Software Quality Plan to the driver documents as well as to two additional ASC program and industry standards requested by the ASC Quality Management Council (AQMC). Figure 1 illustrates the relationship between the software quality plan and the standards and guidelines that are mapped in this document.

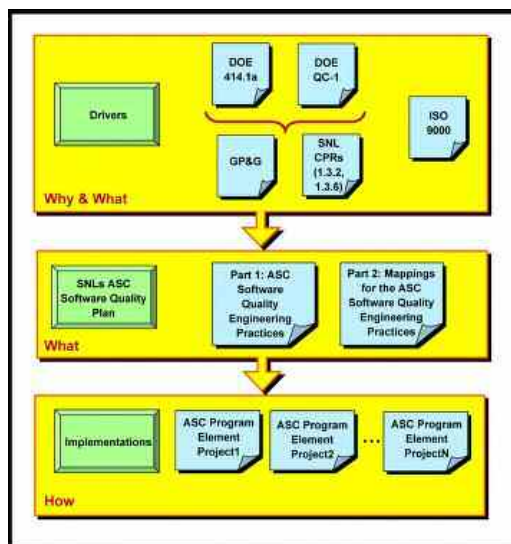


Figure 1. Relationship Between Software Quality Plan and Mapping Documents.

In all mappings provided, practice numbers or sections of Part 1 of the Software Quality Plan are listed to indicate a mapping to a particular requirement. Gaps between the various requirements and the Software Quality Plan are indicated in a light red color. An “N/A” is used where a particular requirement appears non-applicable. No degree of conformance is denoted or implied to the various requirements by the mappings. The practitioner or reader should not interpret indicated mappings to guarantee compliance.

This document is organized as follows:

- Section 1: Introduction
- Section 2: ASC Software Quality Plan Practices and Artifacts Tables
- Section 3: Mappings to the *Department of Energy, DOE/AL Quality Criteria (QC-1)*, Revision 10, February 2004.
- Section 4: Mappings to the *ASCI Software Quality Engineering: Goals, Principles, and Guidelines* (GP&G),
- Section 5: Mappings to the SNL Corporate Process Reports
 - ♦ Section 5.1: CPR001.3.2, Corporate Quality Assurance Program (August 2003)
 - ♦ Section 5.2: CPR001.3.6, Corporate Software Quality Assurance (December 2001)
- Section 6: Mappings to the *ISO 9001:2000 Quality Management Systems – Requirements*, International Standards Organization, December 2000.

2 ASC Software Quality Plan Practices and Artifacts

The following tables provide lists of the practices and artifacts stated in *Part 1: Practices* of the Software Quality Plan.

Practice Number	Description of Software Quality Plan Practices
PR1	Document and maintain a strategic plan.
PR2	Perform a risk-based assessment, determine level of formality and applicable practices, and obtain approvals.
PR3	Document lifecycle processes and their interdependences, and obtain approvals.
PR4	Define, collect, and monitor appropriate process metrics.
PR5	Periodically evaluate quality problems and implement process improvements.
PR6	Identify stakeholders and other requirements sources.
PR7	Gather and manage stakeholders' expectations and requirements.
PR8	Derive, negotiate, manage, and trace requirements.
PR9	Identify and analyze risk events.
PR10	Define, monitor, and implement the risk response.
PR11	Create and manage the project plan.
PR12	Track project performance versus project plan and implement needed (corrective) actions.
PR13	Communicate and review design.
PR14	Create required software and product documentation.
PR15	Identify and track third party software products and follow applicable agreements.
PR16	Identify, accept ownership, and manage assimilation of other software products.
PR17	Perform version control of identified software product artifacts.
PR18	Record and track issues associated with the software product.
PR19	Ensure backup and disaster recovery of software product artifacts.
PR20	Plan and generate the release package.
PR21	Certify that the software product (code and its related artifacts) is ready for release and distribution.
PR22	Distribute release to customers.
PR23	Define and implement a customer support plan.
PR24	Implement the training identified in the customer support plan.
PR25	Evaluate customer feedback to determine customer satisfaction.
PR26	Develop and maintain a software verification plan.
PR27	Conduct tests to demonstrate that acceptance criteria are met and to ensure that previously tested capabilities continue to perform as expected.
PR28	Conduct independent technical reviews to evaluate adequacy with respect to requirements.
PR29	Determine project team training needs to fulfill assigned roles and responsibilities.
PR30	Track training undertaken by project team.

Artifact Number	Description of Software Quality Plan Artifacts
AR1	Strategic plan: [project's mission, management, stakeholders]
AR2	Approved level of formality and applicable practices
AR3	Approved project processes
AR4	Process and product metrics
AR5	Project process improvement actions
AR6	Product expectations and requirements
AR7	Software requirements and attributes
AR8	List of stakeholders and organizational commitments
AR9	Project plan: [risks events, risk plan, overview, milestones, task list, resource information, roles and responsibility assignments, assumptions, constraints, dependencies, budget, schedule, SCM plan, etc.]
AR10	Project reviews and needed (corrective) actions: [risk responses, tracking and oversight responses]
AR11	Design artifacts: [documentation and/or reviews]
AR12	Implementation artifacts: [software code, assimilated other software, design documents, user documentation, developer's guide, installation guide, theory manual, interface manual, etc.]
AR13	Identification and acquisition records
AR14	Version controlled records, including baselines and associated configurations
AR15	Backup records and recovery test results
AR16	Managed issues: [product quality results (for example, non-conformances), enhancements, defects, questions, inquiries]
AR17	Release specification
AR18	Product release package (bill of materials, release notes, certification, software, etc.)
AR19	Customer support plan including training
AR20	Customer training records
AR21	Customer satisfaction evaluation
AR22	Software verification plan
AR23	Test artifacts: [test cases, test results]
AR24	Technical reviews (evidence that review occurred and review results)
AR25	Project team training needs
AR26	Project team training records

3 DOE/AL QC-1 Revision 10 Mappings

The following table maps the requirements of the DOE QC-1 (sections 2.1 through 4.1) to the ASC Software Quality Plan.

QC-1 Section Number	QC-1 Section Title	QC-1 Requirements	ASC Software Quality Plan
2.1	Risk-Based Program	To have a cohesive, effective and integrated quality management system, a risk-based approach must be used to determine the extent (tailoring) of application of QC-1 requirements.	PR1, PR2
2.1		An organization shall use a risk management process when choosing to apply the "shall" requirements of this document in a graded (tailored) manner and document that process in their QAP or WQAP.	PR1, PR2
2.1		Factors that may be considered in the risk management process for graded application include	PR1, PR2
2.1		a. the consequences of malfunction or failure of an item,	PR1, PR2
2.1		b. the inappropriate use of the results of services provided,	PR1, PR2
2.1		c. the probability of the occurrence of the postulated consequences,	PR1, PR2
2.1		d. the design and fabrication complexity of an item or difficulty of performing the service,	PR1, PR2
2.1		e. the need for special controls and oversight of processes, equipment, and performance,	PR1, PR2
2.1		f. the degree to which functional compliance can be demonstrated by inspection, test, or performance verification,	PR1, PR2, PR26, PR27, PR28
2.1		g. the quality history and degree of standardization of an item or service, and	PR1, PR2
2.1		h. the difficulty of repair, replacement, or replication of an item or service.	PR1, PR2
2.2	Quality Management Program	NNSA and its contractors shall integrate quality principles with risk-based analysis into management and work practices at all levels so that missions are accomplished and customer requirements are met.	PR1, PR2, PR9, PR10
2.2		Organizations shall integrate quality management into all facets of work planning and execution.	Software Quality Plan
2.2		A written QAP or WQAP shall be developed, implemented, and maintained that meets the requirements of this document.	Software Quality Plan
2.2		The QAP or WQAP shall	Tables 1 & 2, PR1, PR11
2.2		a. describe the organizational structure, functional responsibilities, levels of authority, and interfaces for those managing, performing, and assessing work;	
2.2		b. identify the organization's senior management positions;	Table 1, PR1
2.2		c. identify QC-1 requirements and other weapon quality requirements contained in contractual documents and their flow down to implementing procedures;	Figure 1, Appendix C, Appendix G, CPR1.3.2, CPR 1.3.6
2.2		d. state the justification for graded (tailored) application of QC-1 requirements (if any); and	Appendix C, Appendix G, Figure 1, PR1, PR2
2.2		e. describe management processes, including planning, scheduling, and resource considerations.	Table 1, PR1, PR11

QC-1 Section Number	QC-1 Section Title	QC-1 Requirements	ASC Software Quality Plan
2.2.1	Submittal, Approval, Implementation and Reporting	NNSA and its contractors responsible for work in any weapon life-cycle phase shall a. submit a QAP or WQAP and implementation plan for achieving full compliance to requirements where not presently in compliance to the appropriate NNSA approval authority,	Software Quality Plan
2.2.1		b. follow the submitted QAP or WQAP and implementation plan, pending response from the NNSA approval authority;	Table 1, PR1, PR11
2.2.1		c. submit any significant changes to the QAP or WQAP and any associated implementation plan for approval and describe how the changes continue to satisfy the quality requirements;	Table 1, PR1, PR11
2.2.1		d. conduct work in accordance with the approved QAP or WQAP and implementation plan;	Software Quality Plan
2.2.1		e. report quality management system and weapon activity metrics annually and on request to provide objective evidence of performance; and	Software Quality Plan
2.2.1		f. provide a management self-assessment report on performance to the QAP or WQAP annually.	Software Quality Plan
2.2.1		The approved organization QAP or WQAP and any associated implementation plan will be the basis for assessment of the organization's weapon quality program.	Software Quality Plan
2.3	Organization	There shall be a process to establish and document the organization structure, functional responsibilities, levels of authority, and lines of communication.	see NWSMU or ASC Organizational structure, Table 1, PR1
2.3		Where more than one organization is involved in the execution of activities, the responsibilities, interfaces, and authority of each organization shall be clearly defined and documented.	see NWSMU or ASC Organizational structure, Table 1, PR1, PR6
2.3		The external interfaces between organizations and the internal interfaces between organizational units, and changes thereto, shall be documented.	see NWSMU or ASC Organizational structure, Table 1, PR1, PR6, PR11
2.3		Personnel verifying quality achievement shall not be directly responsible for performing the work being evaluated and shall have the authority, direct access to management, organizational freedom, and access to work to perform their function.	PR1, section 4.4 Overview Description, PR28
2.4	Early and Continuous Application of Quality Principles	The organization responsible for any product or process design shall ensure that operating, production, and quality requirements are incorporated in the design process as early as feasible.	PR13
2.4		The design process shall provide for the timely identification and evaluation of key elements that are critical to program success and shall provide an objective means to measure design, product, process, and production readiness.	PR1, PR6, PR7, PR8, PR11, PR13, PR29
2.4		Producibility shall be formally addressed in the design and design change processes.	PR13
2.4		The design authority and production organization shall establish and document a process for evaluating producibility.	PR3, PR21
2.4		This process shall require the design and ...	N/A
2.5	Establishing and Validating Requirements	Beginning with development and continuing throughout the life cycle of the activity, processes shall be in place to identify, document, validate, control and maintain customer requirements.	PR3, PR6, PR7, PR8, PR13, PR17, PR18, PR20, PR23, PR26

QC-1 Section Number	QC-1 Section Title	QC-1 Requirements	ASC Software Quality Plan
2.5		Each organization shall document their process, including roles, responsibilities, and interfaces.	PR1, PR3, PR11
2.6	Planning	A risk management process shall be used to determine the extent of formal planning (including quality plans) that is required for development, programs, projects, processes, activities, materials, products, services, functions, product and stockpile certification, or organizational entities	section 4, PR1, PR2, PR9, PR10
2.6		NNSA shall address quality requirements in...	N/A
2.7	Metrics	Each organization shall identify, track, trend, and report metrics and utilize them for corrective action and continuous improvement.	PR3, PR4, PR5
3.0	Quality Requirements		
3.1			
3.1.1	Continuous Improvement Process	Processes to detect and prevent quality problems shall be established and implemented.	PR3, PR4, PR5
3.1.1		Items, services, and processes that do not meet established requirements shall be identified, controlled, and corrected according to the importance of the problem and the work affected.	PR3, PR4, PR5
3.1.1		Correction shall include identifying the causes of problems and working to prevent recurrence.	PR3, PR4, PR5
3.1.1		Item characteristics, process implementation, and other quality related information shall be reviewed and the data analyzed to identify items, services, and processes needing improvement.	PR3, PR4, PR5
3.1.2	Prevention Versus Detection	The objective of a quality management system is to prevent errors and nonconformance, reduce variability, and build quality into products and processes.	section 4.2.3, PR3, PR4, PR5
3.1.2		Fundamental methods such as design of experiments, prototyping, process capability studies, Pareto analyses, and statistical process controls may be used to a. characterize processes,	PR3, PR4, PR5, Appendix F
3.1.2		b. simplify processes,	PR3, PR4, PR5, Appendix F
3.1.2		c. mistake-proof processes,	PR3, PR4, PR5, Appendix F
3.1.2		d. continually reduce product and process variability,	PR3, PR4, PR5, Appendix F
3.1.2		e. identify and minimize the number of unstable or error prone processes, and	PR3, PR4, PR5, Appendix F
3.1.2		f. provide early feedback of engineering and manufacturing data to determine the need for product or process changes.	PR3, PR4, PR5, Appendix F
3.1.3	Quality Cost Management	Quality cost management shall be applied to weapon activities throughout the entire weapon program life cycle.	PR1, PR3, PR11
3.1.3		A method for identifying, recording, and reporting the quality costs shall be established and documented in formal procedures.	PR3, PR11
3.1.3		These costs include but are not limited to cost of prevention, cost of appraisal, cost of internal failure, and cost of external failure.	PR3, PR11

QC-1 Section Number	QC-1 Section Title	QC-1 Requirements	ASC Software Quality Plan
3.1.3		The cost of nonconformance plus the cost of conformance and/or other appropriate cost metrics shall be utilized for performance measurement, problem identification, and problem prevention.	PR11, PR4
3.2	Training	Personnel shall be trained and qualified to ensure they are capable of performing their assigned work.	PR11, PR29, PR30
3.2		Personnel shall be provided continuing training to ensure that job proficiency is maintained.	PR11, PR29, PR30
3.2		Evidence of training, qualification, and certification shall be maintained.	PR11, PR30
3.2		Training is conducted to help ensure that personnel are competent to perform the assigned work to the quality required.	PR11, PR29, PR30
3.2		Competency is based on a combination of factors including education, training, skills and experience.	PR11, PR29, PR30
3.2		Processes are required to ensure that personnel have appropriate and adequate experience, education, skills and training, i.e., ensure the use of competent personnel for assigned work.	PR11, PR29, PR30
3.2		Highly qualified and motivated personnel, who are engaged, should be the goal of any training program.	PR1, PR11, PR29, PR30
3.3	Design	The design authority shall be responsible for the design of items and processes under its responsibility.	PR1, PR11, PR13
3.3		Procedures shall be established and maintained to define and control the design process, including design-related development.	PR1, PR3, PR11, PR13, PR18
3.3.1	Design Input	Design inputs (customer requirements, etc.) shall be identified and documented, and their selection reviewed and approved prior to the final design implementation.	PR3, PR6, PR7, PR8, PR13
3.3.2	Design Process	Items and processes shall be designed using sound engineering/scientific principles and appropriate standards.	PR3, PR13
3.3.2		Designs shall provide a clear link between design inputs and design requirements, including production requirements and specifications.	PR3, PR6, PR7, PR8, PR13
3.3.2		Design work, including changes, shall incorporate applicable requirements and design bases.	PR6, PR7, PR8, PR13, PR17, PR18
3.3.2		Designs shall also incorporate critical characteristics required for function, reliability, interchangeability, design life, safety, and dismantlement.	PR13
3.3.2		Design requirements shall not be more restrictive than essential for achieving required performance with appropriate margin.	PR13
3.3.2		The design authority shall determine and set the value and tolerance for design specifications.	PR13
3.3.2		The design authority should produce designs that minimize the opportunity for incorrect manufacture, assembly, use, or operation.	PR13
3.3.2		Calculations, modeling, and testing shall establish the design parameters and maintain the appropriate margins by taking into account uncertainties associated with the design envelope.	PR9, PR10, PR13, PR26, PR27
3.3.2		Test equipment and instrumentation used. ..	N/A
3.3.2		Design information that supports the disposition...	N/A

QC-1 Section Number	QC-1 Section Title	QC-1 Requirements	ASC Software Quality Plan
3.3.3	Design Verification	The adequacy of designs shall be verified and documented before approval and implementation.	PR13, PR26, PR27, PR28
	Design Reviews	Design reviews shall be conducted by individuals or groups other than those who performed the work to ensure, at the time of the review, that a. design inputs are complete and correct;	PR13, PR26, PR28
		b. assumptions necessary to perform the design are adequately described and valid;	PR8, PR9, PR10, PR13,
		c. applicable design standards are used;	PR13, PR28
		d. computer programs, including mathematical models used in simulation codes, are adequately verified and validated and recorded for future retrieval;	PR26, PR27, PR28
		e. suitable materials, parts, processes, and inspection and testing criteria are specified; and	PR26, PR27, PR28
		f. design qualification methods are adequate.	PR13, PR26, PR28
		The design review process shall accommodate observation or subsequent review(s) by NNSA and/or independent third parties if requested.	PR26, PR28
	Design Qualification	The design authority shall specify the qualification methods to be used to confirm customer requirements are met.	PR13, PR26, PR27
		Qualification test plan(s) shall be developed and documented.	PR26
		Qualification test results shall also be documented.	PR26, PR27, PR28
		The design authority shall obtain concurrence from the using organization that specifications in design documents are complete and the detail is understood.	PR13, PR14
		For the production design, the design authority shall obtain concurrence from the applicable production facilities or organization that the producibility of the design is mutually acceptable.	PR8, PR13, PR14,
3.3.4	Design Documents	A process shall be established for approving, issuing, and distributing designs, including changes.	PR3, PR8, PR13, PR14, PR18
3.3.4		Design information transmitted across organization interfaces shall identify the status of information provided and any incomplete items that require further evaluation, review, or approval.	PR11, PR13,
3.3.5	Design Change Control and Configuration Management	Changes to design inputs and final designs shall be subject to control measures (including design reviews) commensurate with the risk introduced by the change.	PR9, PR10, PR13
3.3.5		These measures shall include evaluation of effects of the changes on the overall design and on any analyses upon which the design is based.	PR1, PR2, PR7, PR8, PR28
3.3.5		A design configuration management process shall be established and documented.	PR13, PR17, PR18, PR19
3.3.5		The process shall ensure that (a) configuration control is established as early as possible in the design process, and	PR3, PR13, PR17
3.3.5		(b) configuration control is applied to design inputs, design calculations and analyses, design qualification, and design documents.	PR3, PR13, PR17
3.3.6	Interface Control	Design interfaces shall be identified and controlled.	PR3, PR13
3.3.7	Records	Complete and accurate records of design shall be maintained and retrievable.	PR13

QC-1 Section Number	QC-1 Section Title	QC-1 Requirements	ASC Software Quality Plan
3.4	Instructions, Procedures and Drawings	Work shall be prescribed by and performed in accordance with documented instructions, procedures, drawings, specifications, other documents, or models that include or reference appropriate quantitative or qualitative acceptance criteria for determining	PR3, PR9, PR10, PR11, PR13
3.4		Current instructions, procedures, drawings, specifications, other documents, and models shall be available to and used by the personnel performing the work.	PR3, PR13, PR14
3.5	Document Control	Documents shall be prepared, reviewed, approved, issued, used, and revised to prescribe processes, specify requirements, or establish design.	PR3, PR4, PR11, PR13, PR14
3.5		A documented process shall be established and maintained to control documents, including models and data.	PR3, PR13, PR14
3.5		The process shall define responsibility for preparing, reviewing, approving, issuing, and distributing documents that are adequate, complete, and correct.	PR3, PR11, PR13, PR20
3.5		The process shall ensure a. identification of controlled documents;	PR14, PR17
3.5		b. identification of individuals responsible for the preparation, review, approval, and distribution of controlled documents;	PR11, PR14, PR17, PR20
3.5		c. review of controlled documents for completeness, and approval prior to distribution;	PR17, PR18, PR20, PR21
3.5		d. correct documents are used;	PR17
3.5		e. documents specify effectivity; and	PR17, PR18
3.5		f. timely release, distribution, and implementation.	PR20, PR21, PR22
3.6		The procurement process shall be documented and ensure that a. procurement documents contain correct requirements;	PR3, PR15, PR16
3.6	Procurement	b. prospective suppliers are evaluated and selected on the basis of specified criteria;	PR3, PR15, PR16
3.6		c. procured items and services meet established requirements and perform as specified; and	PR3, PR15, PR16
3.6		d. Suppliers continue to provide acceptable items and services.	PR3, PR15, PR16
3.6.1		The Purchaser shall select Suppliers on the basis of assessment of ability to meet requirements, including quality requirements.	PR3, PR13, PR15, PR16
3.6.1		Supplier evaluation and selection shall be documented and shall include one or more of the following: a. Supplier's history and current capability for providing an identical or similar product that performs satisfactorily in actual use;	PR15, PR16
3.6.1		b. Supplier's current quality records supported by documented information that can be objectively evaluated; or	PR15, PR16
3.6.1		c. Supplier's capability as determined by a direct evaluation of the facilities, personnel, and the implementation of the Supplier's quality management system.	PR15, PR16
3.6.1		Suppliers shall be monitored with regard to the effectiveness of their quality management system and the quality of their product.	PR3, PR15, PR16
3.6.1	Supplier Evaluation, Selection, and Monitoring	NNSA and its contractors reserve the right to perform quality surveys and inspections at vendor and Supplier locations where materials or services are rendered under a contractor's purchase order or contract.	

QC-1 Section Number	QC-1 Section Title	QC-1 Requirements	ASC Software Quality Plan
3.6.2	Procurement Documentation	Procurement documents shall specify that the Supplier have an effective quality management system that complies with the applicable requirements of this document.	PR15, PR16, section 4.3.2 Overview Description
3.6.2		Procurement documents shall be controlled.	PR17, PR18
3.6.2		They shall identify documentation required, indicate records to be submitted or maintained, and specify record retention and disposition requirements.	PR17, PR18
3.6.2		Procurement documents shall provide for return of nonconforming material, access to the Supplier's facility, and inspection of records by the procuring agency and NNSA.	
3.6.3	Acceptance of Procured Items, Materials and Services	Procurement of Third Party Products	
	Items and Materials	Items and materials shall be evaluated to determine conformance to applicable specifications.	PR15, PR16
		When Supplier provided reports are used as a basis of acceptance, the reported results shall be compared with requirements.	PR15, PR16
		The validity of Supplier provided reports shall be periodically verified by the purchaser by at least one of the following methods: (a) independent evaluation to requirements, or	PR15, PR16, PR28
		(b) assessment (to establish the validity of the Supplier-provided reports).	PR15, PR16, PR28
	Services	In cases involving procurement of services only (such as third party inspection; engineering and consulting services; assessment; and installation, repair, overhaul, or maintenance work), the Purchaser shall accept the service by any or all of the following a) technical variability	PR26, PR27, PR28
		b. surveillance and/or assessment of the activity, or	PR26, PR27, PR28
		c. review of objective evidence for conformance to the procurement document requirements.	PR28
3.6.4	Certificate of Conformance		N/A
3.7	Identification, Control and Status of Items	A process shall be established and documented so that items are identified and controlled to ensure proper use and maintained to prevent damage, loss, or deterioration.	H/W - N/A; S/W - PR17
3.7		Physical identification shall be used where possible.	H/W - N/A; S/W - PR17
3.7		Identification markings shall be applied using materials and methods that provide a clear and legible identification and do not degrade the function or service life of the item.	H/W - N/A; S/W - PR17
3.7		Where practical, markings shall be transferred to each part of an identified item when subdivided and shall not be obliterated or hidden unless other means of identification are substituted.	H/W - N/A; S/W - PR17
3.7		Where physical identification on the item is either impractical or insufficient, physical separation, procedural control, or other appropriate means shall be employed.	H/W - N/A; S/W - PR17
3.7		Markings, authorized stamps, tags, labels, routing cards, physical location, or other suitable means shall identify the status of items from the initial receipt and fabrication of items up to and including use.	H/W - N/A; S/W - PR17

QC-1 Section Number	QC-1 Section Title	QC-1 Requirements	ASC Software Quality Plan
3.7		When required, traceability of an item shall ensure applicable specification and grade of material; heat, batch, lot, part, or serial number; or specified inspection, test, or other records.	H/W - N/A; S/W - PR17
3.7		The process shall provide for maintenance or replacement of markings and identification records due to damage from handling or aging, as well as protection of identifications on items subject to excessive deterioration due to environmental exposure.	H/W - N/A; S/W - PR3, PR17
3.7		The status of inspection and test activities shall be identified either on the items or in documents traceable to the items where it is necessary to ensure that required inspections and tests are performed and that items which have not passed the required	PR26, PR27, PR28
3.7.1	Tooling and Fixtures		N/A
3.7.2	Limited-Life Materials and Components		N/A
3.7.3	Materials or Items Designated for Destructive Testing		N/A
3.7.4	Special Instructions and Environments		N/A
3.8	Control of Processes	Work shall be performed to established technical standards and administrative controls using approved instructions, procedures, or other appropriate means.	PR3, PR17
3.8		To the extent practical, criteria for workmanship shall be stipulated in written standards or by means of representative standards.	PR3, PR17
3.8		Processes shall be characterized, documented, and maintained under controlled conditions to minimize variability and to prevent nonconformance.	PR3, PR17
3.8		Proposed process changes shall be evaluated for their potential impact on quality, producibility, and maintainability prior to incorporation.	PR3, PR4, PR5, PR17
3.8		The design authority and production organization shall jointly qualify processes (including inspection, test, and acceptance processes) and document the qualification prior to use for production and acceptance.	PR3, PR20, PR21, PR26
3.8		Equipment used for process monitoring ...	N/A
3.8		A process to formally suspend weapon work ...	N/A
3.8		The process shall establish measurable criteria...	N/A
3.8		Records shall be maintained for all situations...	N/A
3.8.1	Process Control Methods	When production quantities are sufficient in number, statistical methods (such as statistical process control) shall be used to ensure continuous control over production processes and to identify and continually reduce variability.	PR3, PR4, PR5
3.8.1		When production quantities are not large enough to permit the use of statistical methods, alternative control methods shall be applied, such as 100 percent test and inspection when that degree of rigor is necessary to confirm compliance to specification.	Appendix F
3.8.2	Special Processes	Special processes shall be identified and procedures, processes, and controls implemented to ensure a high level of confidence in the control of product variability and to minimize nonconformances.	PR4, PR5

QC-1 Section Number	QC-1 Section Title	QC-1 Requirements	ASC Software Quality Plan
3.8.2		Special-process equipment and procedures shall be...	N/A
		When the outcome of a special process is dependent upon the skill of the person performing the process, that person shall be certified to written procedure.	PR29, PR30
3.8.2		Evidence of qualification of equipment and procedures and certification of personnel shall be maintained.	PR30
3.8.2		When available, codes and standards (including acceptance criteria for the process) shall be specified or referenced in procedures or instructions.	PR3
3.8.2		For special processes not covered by existing codes and standards or where quality requirements specified exceed those of existing codes or standards, the necessary requirements for qualification of personnel, procedures, or equipment shall be specified or referenced in procedures or instructions.	PR3, PR29, PR30
3.9	Inspection, Test and Acceptance	Inspection and testing of specified items, services, and processes shall be conducted under controlled conditions using established acceptance and performance criteria.	PR4, PR5 (processes), PR27 (software)
3.9		Inspection and test requirements and results shall be documented.	PR26, PR27, PR28
3.9		Equipment used for inspections and tests shall be...	N/A
3.9		Measurement uncertainty requirements and capability of inspection and test processes shall be determined and documented.	PR3, PR4, PR5
3.9		Qualified persons other than those who perform or directly supervise the work being inspected or tested shall perform acceptance inspections and tests verifying product conformance to design criteria.	PR27, PR28
3.9		Where independent inspections and tests are not feasible because of special requirements, the responsible organization shall develop an alternative method, document it and the basis for requesting exception, and obtain design authority approval for use.	PR26
3.9		There shall be a documented process and procedures for contractor submittal of completed product and for NNSA acceptance of that product.	PR3, PR20, PR21, PR26
3.9		The process shall ensure that product was manufactured to and conforms to the correct design definition and that the quality evidence is correct and represents that product.	PR27, PR28
3.9		When automated manufacturing processes are used ...	N/A
3.9		When fixtures, molds, and other such tooling are used ...	N/A
3.9		These devices shall be controlled and recertified...	N/A
3.9		When material requires modification, repair, or...	N/A
3.9		Sampling plans shall prescribe random sampling...	N/A
3.10		Control of Measuring and Test Equipment	N/A
3.11.1		Government-Furnished Material	N/A
3.11.2		NNSA-Accepted Material	N/A
3.12	Nonconformance	Whenever a weapon program requirement of any type is not met, a nonconforming condition exists.	PR5, PR10, PR12, PR18, PR28
3.12		Nonconforming conditions include, but are not limited, to nonconforming operations, activities, procedures, software, and items (including material and product).	PR5, PR10, PR12, PR18, PR28

QC-1 Section Number	QC-1 Section Title	QC-1 Requirements	ASC Software Quality Plan
3.12		When a potential or actual nonconformance is identified, the situation shall be evaluated and appropriate action shall be taken.	PR5, PR10, PR12, PR18, PR28
3.12		A process shall be documented to prescribe actions to address potential and actual nonconforming conditions.	PR3, PR10, PR12, PR18
3.12		Procedures shall be established and maintained that define processes for identifying, investigating, and dispositioning nonconforming conditions.	PR3, PR4, PR5
3.12		These procedures shall clearly define the level and qualification of personnel authorized to disposition nonconformances.	PR3, PR11, PR29
3.12		Personnel performing evaluations to determine disposition of a nonconformance shall have demonstrated competence in the specific area they are evaluating, have an adequate understanding of the requirements, and have access to pertinent background information.	PR11, PR29, PR30
3.12.1	Nonconforming Item Control		N/A
3.12.2	Nonconforming Item Disposition		N/A
3.13	Corrective Action	A process shall be established and documented for corrective action, and procedures shall be established and implemented to a. identify and categorize conditions adverse to quality (including criteria for determining significant conditions adverse to quality);	PR3, PR4, PR5, PR9, PR12
3.13		b. track, trend, and report conditions adverse to quality;	PR10, PR12, PR18
3.13		c. apply compensatory measures;	N/A
3.13		d. perform causal analysis of a significant condition adverse to quality to determine if the condition is incidental or systemic;	PR5, Appendix F
3.13		e. develop and implement corrective action to preclude recurrence;	PR10, PR12
3.13		f. verify that the corrective action precludes a recurrence of the condition adverse to quality; and	
3.13		g. capture and communicate lessons learned internally and to NNSA for use in preventing problems and making improvements.	PR5
3.13		Recurring deficiencies are an indication of systemic failure of the quality management system.	PR1, PR3, PR4, PR5
3.13		Senior management shall take appropriate action to determine the cause(s) and permanently correct the systemic problem.	
3.14	Records	A process shall be established and documented for records management.	PR3
3.14		Records shall be specified, prepared, reviewed, approved, and maintained to demonstrate achievement of quality requirements and effective operation of the quality management system.	section 4.2.3
3.14		Procedures shall be established and implemented for the identification, collection, organization, filing, storage, maintenance, retrieval, distribution, retention, and disposition of records.	
3.14		Records shall be maintained to furnish objective evidence that items or activities meet specified requirements.	PR17, section 4.1 "Artifacts"

QC-1 Section Number	QC-1 Section Title	QC-1 Requirements	ASC Software Quality Plan
3.14		Records shall be identifiable as a record; completely and accurately reflect the work accomplished or information required; be legible; and be traceable to associated requirements, items, and activities.	PR17, section 4.1 "Artifacts"
3.14		Records may be originals, copies, or electronic.	PR17, section 4.1 "Artifacts"
3.14		Records shall be authenticated and dated by authorized personnel.	PR17, section 4.1 "Artifacts"
3.14		Acceptable methods of authentication include statements of authenticity, handwritten signatures, electronic signatures, or any other means that ensure traceability to a specific authenticating individual and organization and to an authentication date.	
3.14		Records shall be stored such that they are readily retrievable in facilities that provide a suitable environment to minimize deterioration or damage and to prevent loss.	PR17, PR19
3.14		Records management shall comply with DOE O 200.1, Information Management Program.	
3.15	Assessments	Management and independent assessments shall be planned and conducted to (a) evaluate item and service quality,	section 5, Table 1, PR25, PR27
3.15		(b) measure the adequacy of work performance, and	Table 1, PR12
3.15		(c) promote improvement.	section 5, Table 1
3.15		Processes for management assessments and independent assessments shall be established and documented.	Table 1, PR3, section 5
3.15		Managers shall assess their management processes.	Table 1, PR2, section 5
3.15		Problems that hinder the organization from achieving its objectives shall be identified and corrected.	Table 1, PR2, section 5
3.15		Personnel performing independent assessments shall have sufficient authority and freedom from the line organization to carry out their responsibilities.	section 5
3.15.1	Assessor Qualification	Personnel conducting independent assessments shall be technically qualified and knowledgeable in the areas assessed.	section 5, PR28
3.15.1		Personnel conducting independent assessments shall be qualified to a documented set of criteria, including education, training, and experience.	section 5, PR28
3.15.2	Scheduling	Risk (considering the status, history, and importance of the activity) shall be used as a basis for scheduling management and independent assessments.	Table 1, section 5
3.15.2		The management and independent assessment schedules and associated risk bases shall be documented.	section 5, PR11
3.15.3	Planning	Management and independent assessment plans shall be established and documented.	section 5, PR11, Table 1
3.15.3		The plans shall identify the objectives, scope, approach, and performance criteria to be used.	section 5, PR12
3.15.4	Performance	Management and independent assessments shall compare actual performance with performance criteria.	section 5, PR12
3.15.4		Objective evidence shall be examined to the depth necessary to determine if requirements and criteria are being met.	section 5, PR11, PR12
3.15.4		Conditions requiring prompt corrective action shall be reported immediately to management of the assessed organization.	section 5, PR11, PR12

QC-1 Section Number	QC-1 Section Title	QC-1 Requirements	ASC Software Quality Plan
3.15.5	Reporting	Management and independent assessment reports shall be prepared, signed and dated by the lead assessor, and sent to the responsible management in accordance with established procedures.	section 5, PR11, PR12
	Management Assessment Reporting	Management assessment reports shall include	PR3, PR11, section 5
		a. an identification and summary of underlying assessments performed,	
		b. a discussion of deficiencies identified and trends,	PR3, PR11, section 5
		c. an evaluation of the effectiveness of corrective actions, and	PR3, PR11, section 5
	Independent Assessment Reporting	d. a discussion of continuous improvement initiatives.	PR3, PR11, section 5
		Independent assessment reports shall	
		a. describe the assessment objectives, scope, approach, and performance requirements and quantitative criteria;	
		b. identify assessors and persons contacted;	
		c. identify documents, material, operations, activities, and conditions assessed;	
		d. present deficiencies observed, and	
	Software Quality Assurance	e. summarize the extent of compliance and performance relative to assessment scope, performance requirements, and associated criteria.	
3.16		A software quality assurance (SQA) process shall be established to provide assurance that software will satisfy customer requirements.	Software Quality Plan
3.16		The process shall apply to software that is purchased, developed under contract, or developed by NNSA or its contractors.	Software Quality Plan
3.16		The SQA process shall address applicable elements of QC-1.	Software Quality Plan
3.16		SQA activities shall be commensurate with the complexity and the risk associated with failure of the software to meet established requirements.	PR2
3.16		A documented risk-based and graded approach shall be used to balance cost, risk and program flexibility.	PR2, Table 1
3.16		The SQA process shall use a software life-cycle management methodology based upon a consensus SQA standard or an equivalently rigorous contractor-specific standard that addresses software development from beginning to end and the flow of activities and it	PR3
3.16		Software life-cycle stages may include	PR3
		a. concept,	
3.16		b. requirements,	PR3
3.16		c. design,	PR3
3.16		d. implementation,	PR3
3.16		e. operation,	PR3
3.16		f. maintenance, and	PR3
3.16		g. retirement.	PR3
3.16		Requirements shall be identified, testable, and controlled.	PR6, PR7, PR8
3.16		Software configuration management shall ensure	PR17
		a. a software baseline is established no later than the completion of the software validation process, and	

QC-1 Section Number	QC-1 Section Title	QC-1 Requirements	ASC Software Quality Plan
3.16		b. changes subsequent to the baseline are traceable to software requirements, approved, documented, and added to the baseline so that the baseline defines the most recently approved software configuration.	PR17, PR18
3.16		Software verification and validation activities shall be controlled, documented, and demonstrate requirements are met.	PR26, PR27, PR28, section 4.4 Overview Description
4.0	Responsibilities		
4.1	Senior Management	Senior NNSA and Contractor management shall a. establish the organization's quality policy;	CPR 1.3.2, CPR 1.3.6, Software Quality Plan
4.1		b. assign responsibility for establishment, implementation, and oversight of the quality management system, including preparation of the QAP or WQAP and any associated implementation plan;	CPR 1.3.2, CPR 1.3.6, Software Quality Plan
4.1		c. actively participate in quality management system development, implementation and improvement;	CPR 1.3.2, CPR 1.3.6, Software Quality Plan
4.1		d. ensure that customer requirements are determined, documented, and met with the aim of enhancing customer satisfaction;	CPR 1.3.2, CPR 1.3.6, Software Quality Plan
4.1		e. review the organization's quality management system at planned intervals to ensure its continuing suitability, adequacy, and effectiveness; and	CPR 1.3.2, CPR 1.3.6, Table 1
4.1		f. take appropriate action to determine the cause(s) of recurring nonconformances and permanently correct the systemic problem.	CPR 1.3.2, CPR 1.3.6, Table 1

4 GP&G Mappings

The following chart maps between the SNL site-specific practices described in *Part 1: Practices* of the Software Quality Plan and the *ASCI Software Quality Engineering: Goals, Principles and Guidelines* (GPP&G), a report developed collaboratively as high-level SQE guidelines for software developed in the Tri-Laboratory ASCI Program.

GP&G SQE Guidelines		SNL Practices
Software Verification	Technical reviews <ul style="list-style-type: none"> Technical soundness Static analysis 	PR26, PR28 PR26, PR28
	Unit testing <ul style="list-style-type: none"> Traceable, repeatable component tests 	PR26, PR27, PR17, PR18
	Regression testing <ul style="list-style-type: none"> Building the code Executing tests Feature-based test suite for multiple platforms 	PR17, PR18, PR19, PR20, PR21 PR27 PR26
	Comparison techniques <ul style="list-style-type: none"> Analytic solutions Other codes' results 	PR26, PR27 PR26, PR27
	User acceptance testing <ul style="list-style-type: none"> Applicability evaluation Usability evaluation Code confidence Results credibility 	PR7, PR8, PR13, PR14, PR20, PR26, PR27, App. E, Table 2, PR28, App. E PR20, PR27, App. E Goals of SQ Plan, PR20, PR27, App. E, App. F Goals of SQ Plan, PR20, PR27, App. E, App. F
	Training <ul style="list-style-type: none"> Verification methods and techniques 	PR29, PR30, Table 1
Software Engineering	Lifecycle management <ul style="list-style-type: none"> Time-based work flow Requirements Design Construction Test Support activities 	PR3 PR6, PR7, PR8 PR13 PR14 PR23, PR24 PR8, PR15, PR16, PR17, PR18, PR19, PR22, PR23, PR24, PR25
	Configuration management <ul style="list-style-type: none"> Version management Issue tracking Release management 	PR15, PR16, PR17 PR18 PR17, PR18, PR19
	Measurements and metrics <ul style="list-style-type: none"> Software products Software processes 	PR4, all practices suggest metrics PR4, all practices suggest metrics
	Reviews and assessments <ul style="list-style-type: none"> Management reviews Technical reviews 	PR12, section 5, App. D PR27, section 5, App. D

GP&G SQE Guidelines		SNL Practices
	Process improvement <ul style="list-style-type: none"> • Engineering process baseline • Identified improvements • Improvement implementation 	PR3 PR5 PR5, PR18, PR21
	Training <ul style="list-style-type: none"> • Software practice methods and techniques 	PR29, PR30, Table 1
Project Management	Risk management <ul style="list-style-type: none"> • Risk assessment • Risk control 	PR9 PR10
	Requirements management <ul style="list-style-type: none"> • Gathering, documenting, verifying, managing change to requirements 	PR6, PR7, PR8, PR26, PR27, PR28, PR18
	Project planning <ul style="list-style-type: none"> • Statement of work • Constraints and goals • Implementation plan • Resource assessment 	PR11 PR11 PR11 PR11
	Tracking and oversight <ul style="list-style-type: none"> • Actual results vs. planned results • Corrective action 	PR12 PR12
	Process management <ul style="list-style-type: none"> • Process documentation and plans • Technology improvement • Improvement leverage 	Table 1, PR3 PR4, section 5, Table 1 PR4, section 5, Table 1
	Training <ul style="list-style-type: none"> • Project management methods and techniques 	PR29, PR30, Table 1

5. SNL Corporate Process Requirements Mappings

This section presents the mappings for the two SNL Corporate Process Requirement (CPR) documents, CPR001.3.2 *Corporate Quality Assurance Program* and CPR001.3.6 *Corporate Software Quality Assurance*.

5.1 SNL CPR001.3.2 Mapping

CPR001.3.2 Requirements	ASC Software Quality Plan
1.0 Purpose	No mapping is required
2.0 Statement of Applicability	Section 1.1, Figure 1, section 2, Table 1, PR1
3.0 Roles and Responsibilities 3.1 The Executive VP 3.2 The Executive Staff Director 3.3 Vice Presidents	Roles and responsibilities for CPR001.3.2 sections 3.0 – 3.3 are outside the scope of the ASC Software Quality Plan
3.4 Directors	Figure 1, section 2, Table 1, PR1, PR2 Gap – No specific tracking or trending requirement for quality.
3.5 Managers and Team Supervisors	Table 1, PR1, PR2, PR3, PR4, PR5, Appendix F Gap – No specific tracking or trending requirement for quality issues in the practices.
3.6 Program and Project Leaders	Table 1, PR1, PR2, PR3, PR4, PR5
3.7 Members of the Workforce	ASC Software Quality Plan
3.8 Quality Assurance Working Group Representatives 3.9 Quality Assurance Working Group (QWAG) 3.10 Quality Program Office (QPO) Manager 3.11 Price-Anderson Amendments Act (PAAA) Program Integration Department Manager 3.12 Audit Center and Surety Assessment Center 3.13 Directors Quality Council (DQC) 3.14 Directors Council on Software Quality 3.15 NWSMU Quality Managers Council	Roles and responsibilities for CPR001.3.2 sections 3.8 – 3.15 are outside the scope of the ASC Software Quality Plan
4.0 Implementation Requirements	Done by Program and Center management – outside scope of ASC Software Quality Plan
4.1 Define Scope of Work	Table 1, PR1, PR2, PR6 Gap – No specific designation of using FLDS to document formality level.
4.2 Define Formality levels	Table 1, PR1, PR2, PR6, PR7, PR8 Gap – No specific designation of using FLDS to document formality level. Gap – PAAA not addressed. Partial Gap – FLDS and formality level not referenced directly.
4.2.1 Formality Level Criteria	Table 1, PR1, PR2, PR6, Table 3
4.2.2 Identify the appropriate level of formality	Table 1, PR1, PR2, PR6 Partial GAP – FLDS and formality level not referenced directly. Gap – PAAA not addressed. Gap – director required approval of LOF of high
4.2.3 Determine PAAA applicability	Gap – PAAA not addressed.

CPR001.3.2 Requirements	ASC Software Quality Plan
4.3 Establish Controls	Section 2, Table 1, PR1, PR2, PR6, PR3 Gap - no specific reference to individuals being able to demonstrate this requirement.
4.3.1 Application of the Graded Approach	Table 1, PR1, PR2, PR6
4.4 Feedback and Improvement	Table 1, PR1, PR3, PR4, PR5, PR12, Section 5, PR28 Gap – reporting quality issues to the QAWG
4.4.1 Trigger Issue Criteria	Gap – no specific reference to escalation of significant quality issues.
5.0 Quality Assurance Criteria The Quality Assurance requirements are taken from DOE O 414.1A "Quality Assurance," and 10 CFR 830, Subpart A "Quality Assurance Requirements." The ten criteria are applied to all scope of work and implemented in accordance with the level of formality using the graded approach. These criteria are categorized according to aspects of Management, Performance, and Assessment.	
Management	
Criteria 1 – Program <ul style="list-style-type: none"> • A written QAP must be developed, implemented, and maintained. • The QAP must describe the organizational structure, functional responsibilities, levels of authority, and interfaces for those managing, performing, and assessing the work. • The QAP must describe management processes, which includes planning, scheduling, and resource considerations. 	ASC Software Quality Plan Table 1, PR1-PR30, Section 5 Table 1, PR1, PR2, PR3, PR11, PR12
Criteria 2 - Personnel Training and Qualification <ul style="list-style-type: none"> • Personnel must be trained and qualified to ensure that they are capable of performing their assigned work. • Personnel must be provided continuing training to ensure that job proficiency is maintained. 	Table 1, PR11, PR29, PR30 Table 1, PR29, PR30
Criteria 3 – quality improvement <ul style="list-style-type: none"> • Process to detect and prevent quality problems must be established and implemented • Items, services and processes that do not meet established requirements must be identified, controlled, and corrected according to the importance of the problems and the work affected. Correction must include identifying the causes of the problems and working to prevent reoccurrence. • Items characteristics, process implementation, and other quality-related information must be reviewed and the data analyzed to identify items, services, and processes needing improvement. 	PR3, PR4, PR5, PR9, PR10, PR12, PR13, PR18, PR27, PR28 PR4, PR5, PR8, PR9, PR10, PR12, PR17, PR18, PR19, PR27, PR28, Appendix E PR3, PR4, PR5, PR10, PR12, PR13, PR17, PR18, PR27, PR28
Criteria 4 – documents and records <ul style="list-style-type: none"> • Documents must be prepared, reviewed, approved, issued, used, and revised to prescribe processes, specify requirements, or establish design. • Records must be specified, prepared, reviewed, approved, and maintained 	PR3, PR4, PR5, PR7, PR8, PR13 PR1-PR30
Performance	
Criteria 5 – Work Processes <ul style="list-style-type: none"> • Work must be performed to establish technical standards and administrative controls, using approved instructions, procedures or other appropriate means • Items must be identified and controlled to ensure their proper use • Items must be maintained to prevent their damage, loss, of deterioration 	Table 1, PR1, PR2, PR3, PR11 PR17 PR 7, PR8, PR9, PR13, PR14, PR17, PR19

CPR001.3.2 Requirements	ASC Software Quality Plan
<ul style="list-style-type: none"> Equipment used for process monitoring or data collection must be calibrated and maintained. 	N/A
Criteria 6 – Design <ul style="list-style-type: none"> Items and processes must be designed using sound engineering/scientific principles and appropriate standards Design work, including changes, must incorporate applicable requirements and design bases Design interfaces must be identified and controlled The adequacy of design products must be verified or validated by individuals or groups other than those who perform the work Verification and validation work must be completed before approval and implementation of the design 	PR3, PR13, PR28 PR7, PR8, PR11, PR12, PR13, PR28 PR13, PR17 PR13, PR26, PR27, PR28, Section 4.4, Overview Description PR26, PR27, PR28 PR27, PR28 address performing test and evaluation of work products, including design. Not all V&V activities will be completed prior to approval of design.
Criteria 7 – Procurement <ul style="list-style-type: none"> Procured items and services must meet established requirements and perform as specified Prospective suppliers must be evaluated and selected on the basis of specified criteria Processes to ensure that approved suppliers continue to provide acceptable items and services must be established and implemented. 	Outside the scope of the ASC Software Quality Plan
Criterion 8 – Inspection and Acceptance Testing <ul style="list-style-type: none"> Inspection and testing of specified items, services, and processes must be conducted using established acceptance and performance criteria Equipment used for inspections and tests must be calibrated and maintained 	Table 1, PR5, PR14, PR26, PR27, PR28 N/A
Assessment	
Criterion 9 – Management Assessment <ul style="list-style-type: none"> Managers must assess their management processes Problems that hinder the organization from achieving its objectives must be identified and corrected 	Table 1, PR1, PR2, PR3, PR4, PR5 Table 1, PR1, PR2, PR3, PR4, PR5, PR8, PR10, PR12
Criterion 10 – Independent Assessment <ul style="list-style-type: none"> Independent assessments must be planned and conducted to measure item and service quality, to measure adequacy of work performance, and to promote improvement. The group performing independent assessment must have sufficient authority and freedom from the line organization to carry out its responsibilities Persons conducting independent assessments must be technically qualified and knowledgeable in the areas assessed 	Table 1, PR12, PR27, PR28, Section 5 Table 1, Section 5 Table 1, Section 5
6.0 Required Records	Table 1, PR1, PR17, Table 6 “Software Quality Plan Artifacts” Gap –FLDS approval
7.0 References 7.1 Drivers 7.2 DOE Guidance 7.3 Sandia Guidance	Section 1, Figure 1, Section 2 addresses GP&G, CPR1.3.2, CPR1.3.6. 414A is now part of QC-1 which is covered by the CPR’s. QC-1 via CPR’s, 414 in QC-1 via CPR’s

5.2 CPR001.3.6 Mappings

CPR001.3.6 Requirements	ASC Software Quality Plan
1.0 Purpose	Part 1: section 1, section 1.1, PR6, PR7, PR8, PR11, PR12, PR21, PR25, PR27, PR28 Establishing confidence in codes is one of the goals of the GP&G. The GP&G's key elements are associated with activities that, in turn, are related to the guideline areas. The guideline areas support the principles that, in turn, support the goals. A mapping has been done between the GP&G activities and key elements and the ASC Software Quality Plan. The GP&G mappings are in both Part 1 (Appendix G) and Part 2 (section 4).
2.0 Statement of Applicability	Part 1: section 1, section 1.1, Figure 1, section 2
3.0 Policy Requirements	Part 1: Table 1, PR1, PR2, PR3, PR4, PR5, PR6 This appears to be a gap in the quality plan. There is no specific reference to reporting and a corporate level in the plan.
1. Project Planning and Oversight	Part 1: PR11, PR12
2. Requirements Management	Part 1: PR1, PR6, PR7, PR8, PR23
3. Configuration Management	Part 1: PR17, PR18
4. Process and Work Product Verification	Part 1: PR27, PR28, Section 5
5. Software Product Engineering	Part 1: PR3, PR7, PR8, PR13, PR14, PR26, PR27, PR28
6. Training	Part 1: PR11, PR29
7. Peer Review of Software Inspection	Part 1: PR26, PR27, PR28
8. Inter-group Coordination	Part 1: Table 1, PR1
4.0 Definitions	No mapping required
5.0 Drivers	No mapping required
6.0 Resources and References	No mapping required
7.0 Attachment: Templates and Examples	No mapping required

6. ISO 9001-2000 Mapping

The following chart maps requirements between *Part 1: Practices* of the Software Quality Plan and the ISO 9001-2000 document.

ISO 9001:2000 Quality Management Systems – Requirements	ASC Software Quality Plan
1 Scope 1.1 General This International Standard specifies requirements for a quality management system where an organization a) needs to demonstrate its ability to consistently provide product that meets customer and applicable regulatory requirements, and b) aims to enhance customer satisfaction through the effective application of the system, including processes for continual improvement of the system and the assurance of conformity to customer and applicable regulatory requirements.	Section 1.1, PR3-5, PR6-8, PR25
1.2 Application All requirements of this International Standard are generic and are intended to be applicable to all organizations, regardless of type, size and product provided. Where any requirement(s) of this International Standard cannot be applied due to the nature of an organization and its product, this can be considered for exclusion. Where exclusions are made, claims of conformity to this International Standard are not acceptable unless these exclusions are limited to requirements within clause 7, and such exclusions do not affect the organization's ability, or responsibility, to provide product that meets customer and applicable regulatory requirements.	ISO 9001:2000 §7.6, Control of monitoring and measuring devices, is an allowed exclusion
2 Normative reference	N/A
3 Terms and definitions For the purposes of this International Standard, the terms and definitions given in ISO 9000 apply. The following terms, used in this edition of ISO 9001 to describe the supply chain, have been changed to reflect the vocabulary currently used: supplier -> organization -> customer Throughout the text of this International Standard, wherever the term “product” occurs, it can also mean “service”.	Some ISO 9000:2000 definitions are referenced in the Glossary (e.g. “requirement”). The set of definitions (which words included) is different. Also, definitions are different from QC-1.
4 Quality management system	
4.1 General requirements The organization shall establish, document, implement and maintain a quality management system and continually improve its effectiveness in accordance with the requirements of this International Standard. The organization shall a) identify the processes needed for the quality management system and their application throughout the organization (see 1.2), b) determine the sequence and interaction of these processes, c) determine criteria and methods needed to ensure that both the operation and control of these processes are effective, d) ensure the availability of resources and information necessary to support the operation and monitoring of these processes, e) monitor, measure and analyze these processes, and f) implement actions necessary to achieve planned results and continual improvement of these processes. These processes shall be managed by the organization in accordance with the requirements of this International Standard. Where an organization chooses to outsource any process that affects product	ASC Software Quality Plan PR1, PR3 PR3 PR3, PR4, PR5 PR4, PR5, PR11 PR3, PR4, PR5 PR5

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conformity with requirements, the organization shall ensure control over such processes. Control of such outsourced processes shall be identified within the quality management system.	
4.2 Documentation requirements	
4.2.1 General The quality management system documentation shall include a) documented statements of a quality policy and quality objectives, b) a quality manual, c) documented procedures required by this International Standard, d) documents needed by the organization to ensure the effective planning, operation and control of its processes, and e) records required by this International Standard (see 4.2.4).	Section 1, Section 2, Section 3 ASC Software Quality Plan ASC Software Quality Plan PR3, PR4, PR5 PR17, PR19
4.2.2 Quality manual The organization shall establish and maintain a quality manual that includes a) the scope of the quality management system, including details of and justification for any exclusions (see 1.2), b) the documented procedures established for the quality management system, or reference to them, and c) a description of the interaction between the processes of the quality management system.	Sections 1-3, PR1, PR2 PR3 PR3
4.2.3 Control of documents Documents required by the quality management system shall be controlled. Records are a special type of document and shall be controlled according to the requirements given in 4.2.4. A documented procedure shall be established to define the controls needed a) to approve documents for adequacy prior to issue, b) to review and update as necessary and re-approve documents, c) to ensure that changes and the current revision status of documents are identified, d) to ensure that relevant versions of applicable documents are available at points of use, e) to ensure that documents remain legible and readily identifiable, f) to ensure that documents of external origin are identified and their distribution controlled, and g) to prevent the unintended use of obsolete documents, and to apply suitable identification to them if they are retained for any purpose.	PR3 PR3 PR17 PR17, PR22 PR17 PR15, PR16, PR17, PR22 PR17, PR22
4.2.4 Control of records Records shall be established and maintained to provide evidence of conformity to requirements and of the effective operation of the quality management system. Records shall remain legible, readily identifiable and retrievable. A documented procedure shall be established to define the controls needed for the identification, storage, protection, retrieval, retention time and disposition of records.	PR3, PR17, PR18, PR19, Section 4.3.3 Configuration Management, Overview Description CPR 400.2.13 defines SNL records policy
5 Management responsibility	
5.1 Management commitment Top management shall provide evidence of its commitment to the development and implementation of the quality management system and continually improving its effectiveness by a) communicating to the organization the importance of meeting customer as well as statutory and regulatory requirements, b) establishing the quality policy, c) ensuring that quality objectives are established, d) conducting management reviews, and e) ensuring the availability of resources.	Commitment, Table 1 Sections 1-3, Table 1, PR1 Sections 1-3, Table 1 Sections 1-3, Table 1 Table 1, PR1, PR12 Table 1, PR1, PR11

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5.2 Customer focus Top management shall ensure that customer requirements are determined and are met with the aim of enhancing customer satisfaction (see 7.2.1 and 8.2.1).	Commitment, Table 1, PR1, PR6, PR7, PR8, PR23, PR24, PR25
5.3 Quality policy Top management shall ensure that the quality policy a) is appropriate to the purpose of the organization, b) includes a commitment to comply with requirements and continually improve the effectiveness of the quality management system, c) provides a framework for establishing and reviewing quality objectives, d) is communicated and understood within the organization, and e) is reviewed for continuing suitability.	 Table 1, PR1 Section 1.1, Figure 1, Section 2, Table 1, PR1 Table 1, PR1 Table 1, PR1 Table 1, PR1
5.4 Planning	
5.4.1 Quality objectives Top management shall ensure that quality objectives, including those needed to meet requirements for product [see 7.1 a)], are established at relevant functions and levels within the organization. The quality objectives shall be measurable and consistent with the quality policy.	Section 1.1, Table 1, PR1
5.4.2 Quality management system planning Top management shall ensure that a) the planning of the quality management system is carried out in order to meet the requirements given in 4.1, as well as the quality objectives, and b) the integrity of the quality management system is maintained when changes to the quality management system are planned and implemented.	 Table 1, PR1 Table 1, PR1
5.5 Responsibility, authority and communication	
5.5.1 Responsibility and authority Top management shall ensure that responsibilities and authorities are defined and communicated within the organization.	Table 1, PR1-3, PR6 , PR11
5.5.2 Management representative Top management shall appoint a member of management who, irrespective of other responsibilities, shall have responsibility and authority that includes a) ensuring that processes needed for the quality management system are established, implemented and maintained, b) reporting to top management on the performance of the quality management system and any need for improvement, and c) ensuring the promotion of awareness of customer requirements throughout the organization. NOTE The responsibility of a management representative can include liaison with external parties on matters relating to the quality management system.	 Table 1, PR1-5, PR7-8, PR11-12, section 5 PR3-5, PR7-8, PR11-12, section 5 PR1, PR3-5, PR7-8, PR11-12,
5.5.3 Internal communication Top management shall ensure that appropriate communication processes are established within the organization and that communication takes place regarding the effectiveness of the quality management system.	Table 1, PR1, PR11
5.6 Management review	
5.6.1 General Top management shall review the organization's quality management system, at planned intervals, to ensure its continuing suitability, adequacy and effectiveness. This review shall include assessing opportunities for improvement and the need for changes to the quality management system, including the quality policy and quality objectives. Records from management reviews shall be maintained (see 4.2.4).	Table 1, PR1, section 5
5.6.2 Review input The input to management review shall include information on a) results of audits,	(audits & audit reports) Table 1, PR1, PR28, section 5 PR6-8, PR25

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b) customer feedback, c) process performance and product conformity, d) status of preventive and corrective actions, e) follow-up actions from previous management reviews, f) changes that could affect the quality management system, and g) recommendations for improvement.	PR9-10, PR11-12, PR13-16, PR17-19, PR27, PR28 PR4, PR10, PR12, PR17 PR11-12 PR5, section 5 Table 1, PR1, PR5, PR12, PR25, PR28, section 5
5.6.3 Review output The output from the management review shall include any decisions and actions related to a) improvement of the effectiveness of the quality management system and its processes, b) improvement of product related to customer requirements, and c) resource needs.	Table 1, PR1 PR11-12 PR11-12 PR1, PR11-12
6 Resource management	
6.1 Provision of resources The organization shall determine and provide the resources needed a) to implement and maintain the quality management system and continually improve its effectiveness, and b) to enhance customer satisfaction by meeting customer requirements.	Table 1, PR1-5 PR1-PR3, PR6-8, PR11, PR25
6.2 Human resources	
6.2.1 General Personnel performing work affecting product quality shall be competent on the basis of appropriate education, training, skills and experience.	Table 1, PR1, PR11-12, PR29-30
6.2.2 Competence, awareness and training The organization shall a) determine the necessary competence for personnel performing work affecting product quality, b) provide training or take other actions to satisfy these needs, c) evaluate the effectiveness of the actions taken, d) ensure that its personnel are aware of the relevance and importance of their activities and how they contribute to the achievement of the quality objectives, and e) maintain appropriate records of education, training, skills and experience (see 4.2.4).	PR29 PR30 PR12, PR28 PR11, PR29 PR30
6.3 Infrastructure The organization shall determine, provide and maintain the infrastructure needed to achieve conformity to product requirements. Infrastructure includes, as applicable a) buildings, workspace and associated utilities, b) process equipment (both hardware and software), and c) supporting services (such as transport or communication).	PR1, PR11 PR13, PR15-16 PR1, PR11-12
6.4 Work environment The organization shall determine and manage the work environment needed to achieve conformity to product requirements.	PR1, PR11
7 Product realization	
The organization shall plan and develop the processes needed for product realization. Planning of product realization shall be consistent with the requirements of the other processes of the quality management system (see 4.1). In planning product realization, the organization shall determine the following, as appropriate: a) quality objectives and requirements for the product; b) the need to establish processes, documents, and provide resources specific to	PR1-3, PR6-8, PR20 PR1-3, PR11, PR20

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<p>the product;</p> <p>c) required verification, validation, monitoring, inspection and test activities specific to the product and the criteria for product acceptance;</p> <p>d) records needed to provide evidence that the realization processes and resulting product meet requirements (see 4.2.4).</p>	<p>PR8, PR11-12, PR17-19, PR21, PR26-28</p> <p>PR17-19, PR21, PR26-28</p>
7.2 Customer-related processes	
<p>7.2.1 Determination of requirements related to the product</p> <p>The organization shall determine</p> <p>a) requirements specified by the customer, including the requirements for delivery and post-delivery activities,</p> <p>b) requirements not stated by the customer but necessary for specified or intended use, where known,</p> <p>c) statutory and regulatory requirements related to the product, and</p> <p>d) any additional requirements determined by the organization.</p>	<p>PR6-8, PR23</p> <p>PR6-8, PR23</p> <p>PR8, PR13, PR15-16</p> <p>PR8, PR9-10</p>
<p>7.2.2 Review of requirements related to the product</p> <p>The organization shall review the requirements related to the product. This review shall be conducted prior to the organization's commitment to supply a product to the customer (e.g. submission of tenders, acceptance of contracts or orders, acceptance of changes to contracts or orders) and shall ensure that</p> <p>a) product requirements are defined,</p> <p>b) contract or order requirements differing from those previously expressed are resolved, and</p> <p>c) the organization has the ability to meet the defined requirements.</p> <p>Records of the results of the review and actions arising from the review shall be maintained (see 4.2.4).</p> <p>Where the customer provides no documented statement of requirement, the customer requirements shall be confirmed by the organization before acceptance. Where product requirements are changed, the organization shall ensure that relevant documents are amended and that relevant personnel are made aware of the changed requirements.</p>	<p>Table 1, PR1, PR28</p> <p>PR6-8</p> <p>PR8, PR11-12</p> <p>PR9-10, PR11-12</p>
<p>7.2.3 Customer communication</p> <p>The organization shall determine and implement effective arrangements for communicating with customers in relation to</p> <p>a) product information,</p> <p>b) enquiries, contracts or order handling, including amendments, and</p> <p>c) customer feedback, including customer complaints.</p>	<p>PR6-8, PR13, PR23-PR25</p> <p>PR6-8, PR13, PR23-PR25</p> <p>PR6-8, PR23-PR25</p>
7.3 Design and development	
<p>7.3.1 Design and development planning</p> <p>The organization shall plan and control the design and development of product. During the design and development planning, the organization shall determine</p> <p>a) the design and development stages,</p> <p>b) the review, verification and validation that are appropriate to each design and development stage, and</p> <p>c) the responsibilities and authorities for design and development.</p> <p>The organization shall manage the interfaces between different groups involved in design and development to ensure effective communication and clear assignment of responsibility. Planning output shall be updated, as appropriate, as the design and development progresses.</p>	<p>PR1- 3, PR11, PR13</p> <p>PR11, PR13, PR26</p> <p>PR1, PR6, PR11, PR13</p>
<p>7.3.2 Design and development inputs</p> <p>Inputs relating to product requirements shall be determined and records maintained (see 4.2.4). These inputs shall include</p> <p>a) functional and performance requirements,</p> <p>b) applicable statutory and regulatory requirements,</p> <p>c) where applicable, information derived from previous similar designs, and</p> <p>d) other requirements essential for design and development.</p>	<p>PR1, PR3, PR6-8, PR13</p> <p>PR6-8, PR13, PR15-16</p> <p>PR6-8, PR13, PR15-16</p>

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<p>These inputs shall be reviewed for adequacy. Requirements shall be complete, unambiguous and not in conflict with each other.</p>	<p>PR9-10, PR28</p>
<p>7.3.3 Design and development outputs The outputs of design and development shall be provided in a form that enables verification against the design and development input and shall be approved prior to release. Design and development outputs shall a) meet the input requirements for design and development, b) provide appropriate information for purchasing, production and for service provision, c) contain or reference product acceptance criteria, and d) specify the characteristics of the product that are essential for its safe and proper use.</p>	<p>PR13, PR15-16, PR28 PR13, PR15-16, PR28 PR27-28 PR23</p>
<p>7.3.4 Design and development review At suitable stages, systematic reviews of design and development shall be performed in accordance with planned arrangements (see 7.3.1) a) to evaluate the ability of the results of design and development to meet requirements, and b) to identify any problems and propose necessary actions. Participants in such reviews shall include representatives of functions concerned with the design and development stage(s) being reviewed. Records of the results of the reviews and any necessary actions shall be maintained (see 4.2.4).</p>	<p>Table 1, PR1, PR3, PR11, PR13, PR17-19, PR28 PR5, PR8, PR12, PR17-19</p>
<p>7.3.5 Design and development verification Verification shall be performed in accordance with planned arrangements (see 7.3.1) to ensure that the design and development outputs have met the design and development input requirements. Records of the results of the verification and any necessary actions shall be maintained (see 4.2.4).</p>	<p>PR17-19, PR26-28</p>
<p>7.3.6 Design and development validation Design and development validation shall be performed in accordance with planned arrangements (see 7.3.1) to ensure that the resulting product is capable of meeting the requirements for the specified application or intended use, where known. Wherever practicable, validation shall be completed prior to the delivery or implementation of the product. Records of the results of validation and any necessary actions shall be maintained (see 4.2.4).</p>	<p>PR17-19, PR26-28</p>
<p>7.3.7 Control of design and development changes Design and development changes shall be identified and records maintained. The changes shall be reviewed, verified and validated, as appropriate, and approved before implementation. The review of design and development changes shall include evaluation of the effect of the changes on constituent parts and product already delivered. Records of the results of the review of changes and any necessary actions shall be maintained.</p>	<p>PR8, PR13, PR17-19, PR23-25, PR26-28, PR15-16</p>
<p>7.4 Purchasing</p>	
<p>7.4.1 Purchasing process The organization shall ensure that purchased product conforms to specified purchase requirements. The type and extent of control applied to the supplier and the purchased product shall be dependent upon the effect of the purchased product on subsequent product realization or the final product. The organization shall evaluate and select suppliers based on their ability to supply product in accordance with the organization's requirements. Criteria for selection, evaluation and re-evaluation shall be established. Records of the results of evaluations and any necessary actions arising from the evaluation shall be maintained (see 4.2.4).</p>	<p>PR15-16, PR17-19</p>

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and records maintained (see 4.2.4). NOTE Customer property can include intellectual property.	
7.5.5 Preservation of product The organization shall preserve the conformity of product during internal processing and delivery to the intended destination. This preservation shall include identification, handling, packaging, storage and protection. Preservation shall also apply to the constituent parts of a product.	PR15-16, PR17-19, , PR20-21, PR 26-28
7.6 Control of monitoring and measuring devices The organization shall determine the monitoring and measurement to be undertaken and the monitoring and measuring devices needed to provide evidence of conformity of product to determined requirements (see 7.2.1). The organization shall establish processes to ensure that monitoring and measurement can be carried out and are carried out in a manner that is consistent with the monitoring and measurement requirements. Where necessary to ensure valid results, measuring equipment shall a) be calibrated or verified at specified intervals, or prior to use, against measurement standards traceable to international or national measurement standards; where no such standards exist, the basis used for calibration or verification shall be recorded; b) be adjusted or re-adjusted as necessary; c) be identified to enable the calibration status to be determined; d) be safeguarded from adjustments that would invalidate the measurement result; e) be protected from damage and deterioration during handling, maintenance and storage. In addition, the organization shall assess and record the validity of the previous measuring results when the equipment is found not to conform to requirements. The organization shall take appropriate action on the equipment and any product affected. Records of the results of calibration and verification shall be maintained (see 4.2.4). When used in the monitoring and measurement of specified requirements, the ability of computer software to satisfy the intended application shall be confirmed. This shall be undertaken prior to initial use and reconfirmed as necessary.	N/A This is applicable for validation activities that rely on experiments and associated test equipment; excluded for software development w/o measurement instruments
8 Measurement, analysis and improvement	
8.1 General The organization shall plan and implement the monitoring, measurement, analysis and improvement processes needed a) to demonstrate conformity of the product, b) to ensure conformity of the quality management system, and c) to continually improve the effectiveness of the quality management system. This shall include determination of applicable methods, including statistical techniques, and the extent of their use.	Each phase contains a set of metrics to assess conformity of product. PR26-28 Table 1, PR1 Table 1, PR1, PR3-5
8.2 Monitoring and measurement	
8.2.1 Customer satisfaction As one of the measurements of the performance of the quality management system, the organization shall monitor information relating to customer perception as to whether the organization has met customer requirements. The methods for obtaining and using this information shall be determined.	PR6, PR7, PR23, PR25
8.2.2 Internal audit The organization shall conduct internal audits at planned intervals to determine whether the quality management system a) conforms to the planned arrangements (see 7.1), to the requirements of this International Standard and to the quality management system requirements	Table 1, PR1, PR28, section 5

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<p>established by the organization, and b) is effectively implemented and maintained.</p> <p>An audit program shall be planned, taking into consideration the status and importance of the processes and areas to be audited, as well as the results of previous audits. The audit criteria, scope, frequency and methods shall be defined. Selection of auditors and conduct of audits shall ensure objectivity and impartiality of the audit process. Auditors shall not audit their own work.</p> <p>The responsibilities and requirements for planning and conducting audits, and for reporting results and maintaining records (see 4.2.4) shall be defined in a documented procedure. The management responsible for the area being audited shall ensure that actions are taken without undue delay to eliminate detected nonconformities and their causes. Follow-up activities shall include the verification of the actions taken and the reporting of verification results (see 8.5.2).</p>	<p>Table 1, PR1, PR28, section 5</p>
<p>8.2.3 Monitoring and measurement of processes</p> <p>The organization shall apply suitable methods for monitoring and, where applicable, measurement of the quality management system processes. These methods shall demonstrate the ability of the processes to achieve planned results. When planned results are not achieved, correction and corrective action shall be taken, as appropriate, to ensure conformity of the product.</p>	<p>Table 1, PR1, PR3-5 , section 5</p>
<p>8.2.4 Monitoring and measurement of product</p> <p>The organization shall monitor and measure the characteristics of the product to verify that product requirements have been met. This shall be carried out at appropriate stages of the product realization process in accordance with the planned arrangements (see 7.1).</p> <p>Evidence of conformity with the acceptance criteria shall be maintained. Records shall indicate the person(s) authorizing release of product (see 4.2.4). Product release and service delivery shall not proceed until the planned arrangements (see 7.1) have been satisfactorily completed, unless otherwise approved by a relevant authority and, where applicable, by the customer.</p>	<p>PR26-28, PR1, PR7-8, PR17-19, PR20-22</p>
<p>8.3 Control of nonconforming product</p> <p>The organization shall ensure that product which does not conform to product requirements is identified and controlled to prevent its unintended use or delivery. The controls and related responsibilities and authorities for dealing with nonconforming product shall be defined in a documented procedure.</p> <p>The organization shall deal with nonconforming product by one or more of the following ways:</p> <ul style="list-style-type: none"> a) by taking action to eliminate the detected nonconformity; b) by authorizing its use, release or acceptance under concession by a relevant authority and, where applicable, by the customer; c) by taking action to preclude its original intended use or application. <p>Records of the nature of nonconformities and any subsequent actions taken, including concessions obtained, shall be maintained (see 4.2.4).</p> <p>When nonconforming product is corrected it shall be subject to re-verification to demonstrate conformity to the requirements. When nonconforming product is detected after delivery or use has started, the organization shall take action appropriate to the effects, or potential effects, of the nonconformity.</p>	<p>PR13-16, PR26-28, PR17-19 PR1, PR11, PR13, , PR7-8, PR23 PR13-16, PR26-28, PR17-19</p>
<p>8.4 Analysis of data</p> <p>The organization shall determine, collect and analyze appropriate data to demonstrate the suitability and effectiveness of the quality management system and to evaluate where continual improvement of the effectiveness of the quality management system can be made. This shall include data generated as a result of monitoring and measurement and from other relevant sources. The analysis of data shall provide information relating to</p> <ul style="list-style-type: none"> a) customer satisfaction (see 8.2.1), 	<p>Section 5</p> <p>PR23, PR25</p>

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b) conformity to product requirements (see 7.2.1), c) characteristics and trends of processes and products including opportunities for preventive action, and d) suppliers.	PR1, PR6-8, PR26-28 PR3-5 PR15, PR16
8.5 Improvement	
8.5.1 Continual improvement The organization shall continually improve the effectiveness of the quality management system through the use of the quality policy, quality objectives, audit results, analysis of data, corrective and preventive actions and management review.	Table 1, PR1-5, PR12, PR28, section 5
8.5.2 Corrective action The organization shall take action to eliminate the cause of nonconformities in order to prevent recurrence. Corrective actions shall be appropriate to the effects of the nonconformities encountered. A documented procedure shall be established to define requirements for a) reviewing nonconformities (including customer complaints), b) determining the causes of nonconformities , c) evaluating the need for action to ensure that nonconformities do not recur, d) determining and implementing action needed, e) records of the results of action taken (see 4.2.4), and f) reviewing corrective action taken.	PR5, PR12, PR17-19, PR25, PR28, section 5
8.5.3 Preventive action The organization shall determine action to eliminate the causes of potential nonconformities in order to prevent their occurrence. Preventive actions shall be appropriate to the effects of the potential problems. A documented procedure shall be established to define requirements for a) determining potential nonconformities and their causes, b) evaluating the need for action to prevent occurrence of nonconformities, c) determining and implementing action needed, d) records of results of action taken (see 4.2.4), and e) reviewing preventive action taken.	PR5, PR12, PR17-19, PR26-28, section 5

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